INSTRUCTION MANUAL

FOR

MODEL TTS 75A
RELAY TIMING TEST SET

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

(603) 224-7466

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SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 DESCRIPTION

1.2 The Model TTS 75A is a compact, transistorized Relay Timing Test Set designed to test the hold and release time of slow to release relays and the operate time of slow to operate relays. The unit normally is used in conjunction with a relay current flow test set so that the proper current flow and battery supply can be provided to the relay or other apparatus being tested. The unit may also be used in applications not requiring a current flow test set.

1.3 The TTS 75A is essentially a variable pulse generator. It can provide pulses with both the "make" and "break" intervals variable or with one interval fixed and the other variable. Either may be used to make or break, depending upon which output jack is used.

1.4 Interval time may be selected from a preset range providing 22 selections ranging from 50 ms to 750 ms or a continuous range, adjustable from 10 ms to 1 sec. The fixed interval time is 222 ms.

1.5 The starting and stopping of pulses is under control of a key switch on the unit or from a TTS 75RCA Remote Control Unit.

1.6 An adjustable leather strap is provided to permit use on ladders.

1.7 The unit operates from 48 volt central office battery and is contained in an aluminum carrying case. The total weight is $7\frac{1}{4}$ lb.

1.8 SPECIFICATIONS

RANGE OF PULSE WIDTHS:

A and B switches: 50 ms to 750 ms in fixed increments.

A and B TIME-MS controls: 10 to 1000 ms continuously adjustable over two ranges.

Fixed: 222 ms.

ACCURACY:

A and B switches: Better than ±2 ms ±2%.

A and B TIME-MS controls: Better than ±2 ms ±2%.

Fixed: Better than 2%.

POWER SOURCE

48V office battery
190 mA normal operation

MODES OF OPERATION

Continuous pulses - both intervals variable.

Continuous pulses - both intervals fixed at 222 ms.

REMOTE CONTROL (TTS 75RCA)

Controls pulsing and circuit release remotely from the set.

ADDITIONAL 48V JACK

To supply power to associated equipment.

TEMPERATURE STABILITY: Better than 2 ms ± 2%. From 25° to 125°F.

CONTACT RATING

The output relay contacts are rated at 2 amps.

Fig. 1-1 Model TTS 75RCA Remote Control Unit

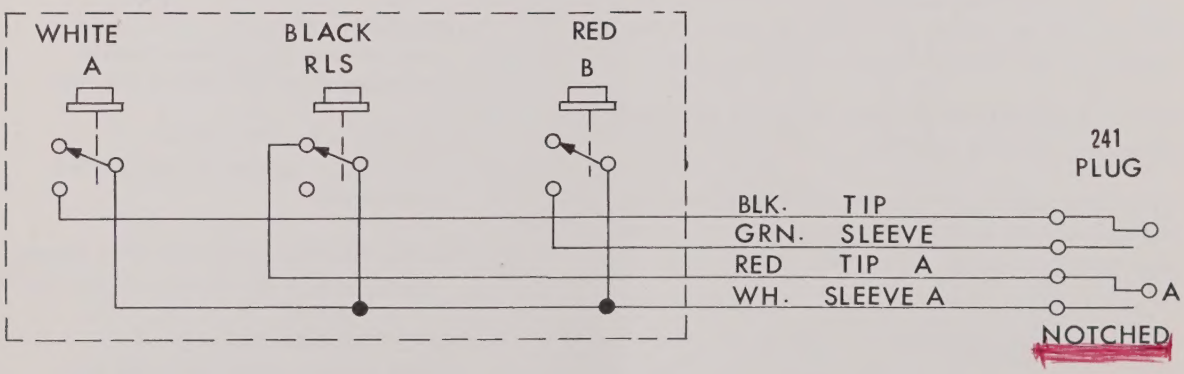


Fig. 1-2 Model TTS 75RCA Schematic Diagram

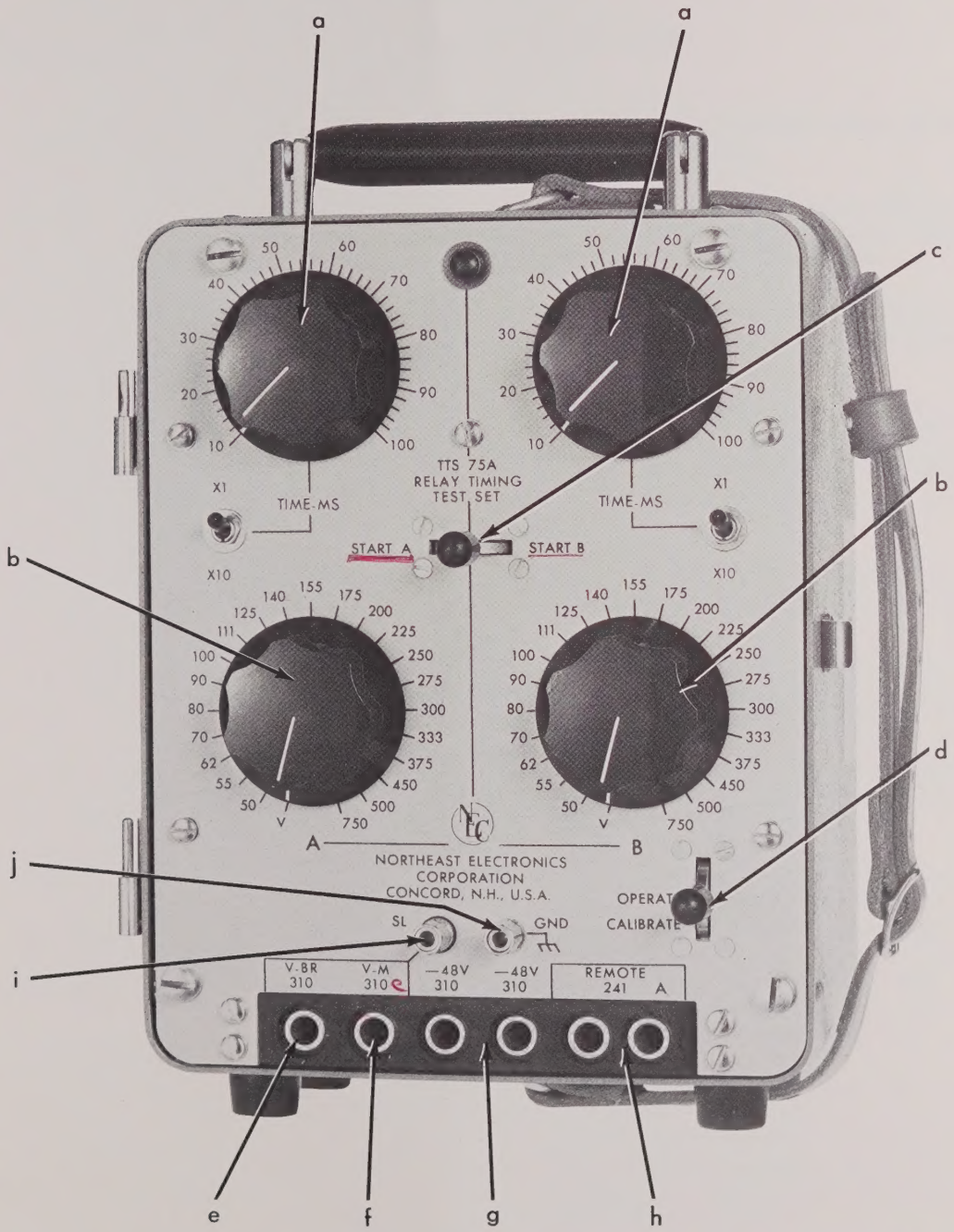


Figure 2-1 Front Panel Controls

230-200-507

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS

a A and B TIME MS Control. There are two controls, each continuously adjustable from 10 ms to 1000 ms in two ranges, selected by X1 and X10 positions of the multiplier switches. These controls determine the time in milliseconds of the two intervals of the make, break pulse train, which appears at the B-BR and the V-M output jacks.

b A and B Switches (Preset Values). There are two rotary switches, each having preset intervals of 50 to 750 ms (50, 55, 62, 70, 80, 90, 100, 111, 125, 140, 155, 175, 200, 225, 250, 275, 300, 333, 375, 450, 500, 750). These switches determine the time in ms of the time intervals of the make break pulse trains which appears at the V-BR and V-M output jacks. The V position switches out the preset intervals and switches in the continuously adjustable controls (A and B TIME MS controls).

c START A-START B Key Switch. A locking key switch selecting one of three positions.

1. START A selects either the A TIME MS control or the A switch time interval as the break interval appearing at the V-BR jack, and the make interval appearing at the V-M jack. For example: If A TIME MS is set at 50 ms and the A switch is set at V, the break interval at the V-BR jack would be 50 ms and the make interval at the V-M jack would also be 50 ms.

2. START B selects either the B TIME MS control or the B switch time interval as the break interval appearing at the V-BR jack and the make interval appearing at the V-M jack.

3. Center position. In this position, the timing circuit is stopped by releasing K3 and K4.

d OPERATE/CALIBRATE Key Switch. A locking key switch selecting one of two positions.

1. OPERATE provides continuous pulses with one interval fixed at 222 ms and the other interval selectable as determined by the appropriate A or B setting.

2. CALIBRATE provides continuous pulses with both intervals variable.

e V-BR Jack. This jack, a tip-ring connection for 310 type plugs, is connected to the normally closed contacts of the output relay. The break interval of these contacts is selected by the setting of either the A or B switch or B TIME MS control.

f V-M Jack. This jack, a tip-ring connection for 310 type plug, is connected to the normally open contacts of the output relay. The make interval of these contacts is selected by the setting of either the A or B switch or the A or B TIME MS control.

g 48V Jacks. Both these jacks, tip negative, sleeve positive, for 310 type plugs, are connected in parallel. One is for supplying power to the set. The other is to supply power to the current flow test set, if used.

h REMOTE-241 Jack. A twin jack for type 241 plug is used in the TTS 75RCA Remote Control Unit. When inserting the plug, the notched side must match

the jack designated A.

i SL Binding Post. A metal binding post connecting to the sleeves of the V-BR and V-M jacks.

j CHASSIS GROUND Binding Post. A metal binding post connected to the chassis which is positive battery.

2.2 OPERATING INSTRUCTIONS

2.3 INITIAL STEPS. Using a cord with a tip-sleeve plug, connect it to either of the 48 volt jacks. Connect the other end of the cord to a 48 volt battery supply. The tip must be connected to battery negative and the sleeve to ground. If the correct connection is made, the green indicator lamp will light. For proper operation, the DC power supply should be 48 volts ± 10 volts. If either the A or B switch do not have the intervals of time to perform the desired tests, the continuously variable A TIME MS control or B TIME MS control may be used. For maximum accuracy in the 222 ms fixed interval, the X1 - X10 multiplier switches must be in the X1 position.

2.4 TO TEST OPERATE TIME

a. To test the operate time of a relay, connect the relay coil to the V-M jack.

b. Set the OPERATE/CALIBRATE key to OPERATE.

c. Set the A switch to the interval which corresponds to the requirements of the relay operate time.

d. Place the START A-START B key in START A position. The relay coil under test will be energized for intervals corresponding to the time set up on the A switch. By observing the relay contacts, its operation can be verified. It will be de-energized for 222 ms.

2.5 TO TEST OPERATE AND NON-OPERATE TIMES

a. Certain classes of relays are slow to operate and have the requirements they must not operate in a given time, but must operate in a second longer time. These may be tested as follows:

b. Connect the relay under test to the V-M jack.

c. On the A dial set up the non-operate time.

d. On the B dial set up the operate time.

e. Place OPERATE/CALIBRATE key in OPERATE position.

f. Place START A-START B key in START A position. Relay should not operate.

g. Place START A-START B key in START B position. Relay should operate.

2.6 TO RELEASE THE CIRCUIT.

a. Certain relays will not release in the 222 ms de-energized time provided. When operated, they will remain operated. These relays may be de-energized by selecting a longer de-energized time period with the TIME MS or preset value control.

2.7 TO TEST RELEASE TIME

a. Connect the relay under test to the V-BR jack.

b. Set OPERATE/CALIBRATE key to OPERATE.

c. Set the desired time on the A switch.

d. Set START A-START B key to START A. The relay is now de-energized for the desired interval of time indicated by the A switch.

2.8 TO TEST SLOW RELAYS

a. Certain relays must not release in a given time, but must release in a second longer time.

b. On the A switch, set up the time corresponding to that where the relay must not release.

c. On the B switch, set up the time where the relay must release.

d. Place START A-START B key on START A. Relay should not release.

e. Place START A-START B key to START B. Relay should release.

2.9 TO OPERATE BY REMOTE CONTROL.

a. Connect the relay under test to either V-M or V-BR jacks, depending on the type of test being conducted.

b. Connect the TTS 75RCA 241 plug to REMOTE 241. Be sure that the notched side of this plug is in the jack marked A. This automatically selects the remote mode.

c. Set A or B switch as indicated in previous paragraphs.

d. Depress the A or B button. Depressing the A button is the same as operating the START A-START B key to START A. This step replaces that of the previous paragraphs. Depressing the B button is the same as operating the START A-START B key to START B. However, when switching from A to B or B to A, the RLS button must be depressed.

SECTION 3

CIRCUIT DESCRIPTION

3.1 CIRCUIT DESCRIPTION

3.2 The schematic diagram for the Model TTS 75A is shown in Fig. 3-1.

3.3 The circuitry of the unit consists of four main parts:

a. An A-stable multivibrator for timing.

b. An output driving stage (Q4) and output polar relay (K2) coupling the timed intervals to the V-BR jack and the V-M jack.

c. Relays and switches for various modes of operation.

d. 24 volt regulator for stable operation of the timing circuit.

3.4 TIMING CIRCUIT

3.5 The timing circuit used in the TTS 75A is a standard A-stable multivibrator. When relay K4 is energized the base of Q1A is released from ground and the circuit operation begins.

3.6 OUTPUT DRIVING CIRCUITRY. The output transistor stage, Q4, is driven by either the collector of Q1A or the collector of Q3B as selected by the START A-START B switch, S1. A reed relay, K1, in the collector of Q4, drives output relay K2. K2 is a polar relay with its form C contacts connected to the V-BR and V-M jacks.

3.7 A and B (Preset Value Switches S5 and S6). Switches S5 and S6, rotary switches for preset increments of time (as listed in Section 2), switch different values of resistance into the timing circuit to change the CR time constants for the required outputs.

3.8 START A-START B Key (S1)

a. START A energizes relay K4 to connect the output circuit to the collector of Q3B and to start the multivibrator running.

b. START B energizes relays K4 and K3. Relay K3 switches the output to the collector of Q1A, ties the base of Q3B to ground and releases the base of Q1A from ground. Relay K4 releases the base of Q3B from ground and starts the multivibrator running.

c. Center position shorts the V-BSR jacks, opens the V-M jacks, and connects a ground to the remote control jacks.

3.9 OPERATE/CALIBRATE Switch (S4).

a. OPERATE. Switches out the A or B TIME-MS control and the A or B switch. Switches in the fixed time interval control R29 or R30, which fixes one of the timed intervals at a nominal 222 ms. For instance, if the START A-START B switch is at START A, then the collector of Q3B will be at -24 volts for 222 ms.

b. CALIBRATE. The fixed time interval (222 ms) is switched out of the circuit, allowing both sides of the interval to be adjustable.

3.10 DC VOLTAGE REGULATOR. The -24 volts supplied to the multivibrator is regulated by a shunt zener regulator circuit CR2, C7 and R14.

3.11 REMOTE CONTROL HEAD (TTS 75RCA) The remote control head performs the same function as the START A-START B switch. With the START A-START B switch in the center position, a path is provided through the remote control head to operate relay K4 if button A is depressed. If button B is depressed, a path is provided to operate relays K3 and K4

Table of Resistor Values for S5 and S6					
Resistor	Value	S5 Sw	Resistor	Value	S6 Sw
R39	2.4K	50	R50	10K	175
R40	4.5K	55	R 1	11.84K	200
R41	3K30	62	R52	12.40K	225
R42	4.32K	70	R53	14114	250
R43	4990	80	R54	15.23K	275
R44	5K1	90	R55	16.12K	300
R45	5K6	100	R56	18.08K	333
R46	6.65K	111	R57	20K	375
R47	7.50K	125	R58	24208	450
R48	8.25K	140	R59	27.4K	500
R49	9040	155	R60	40.2K	750

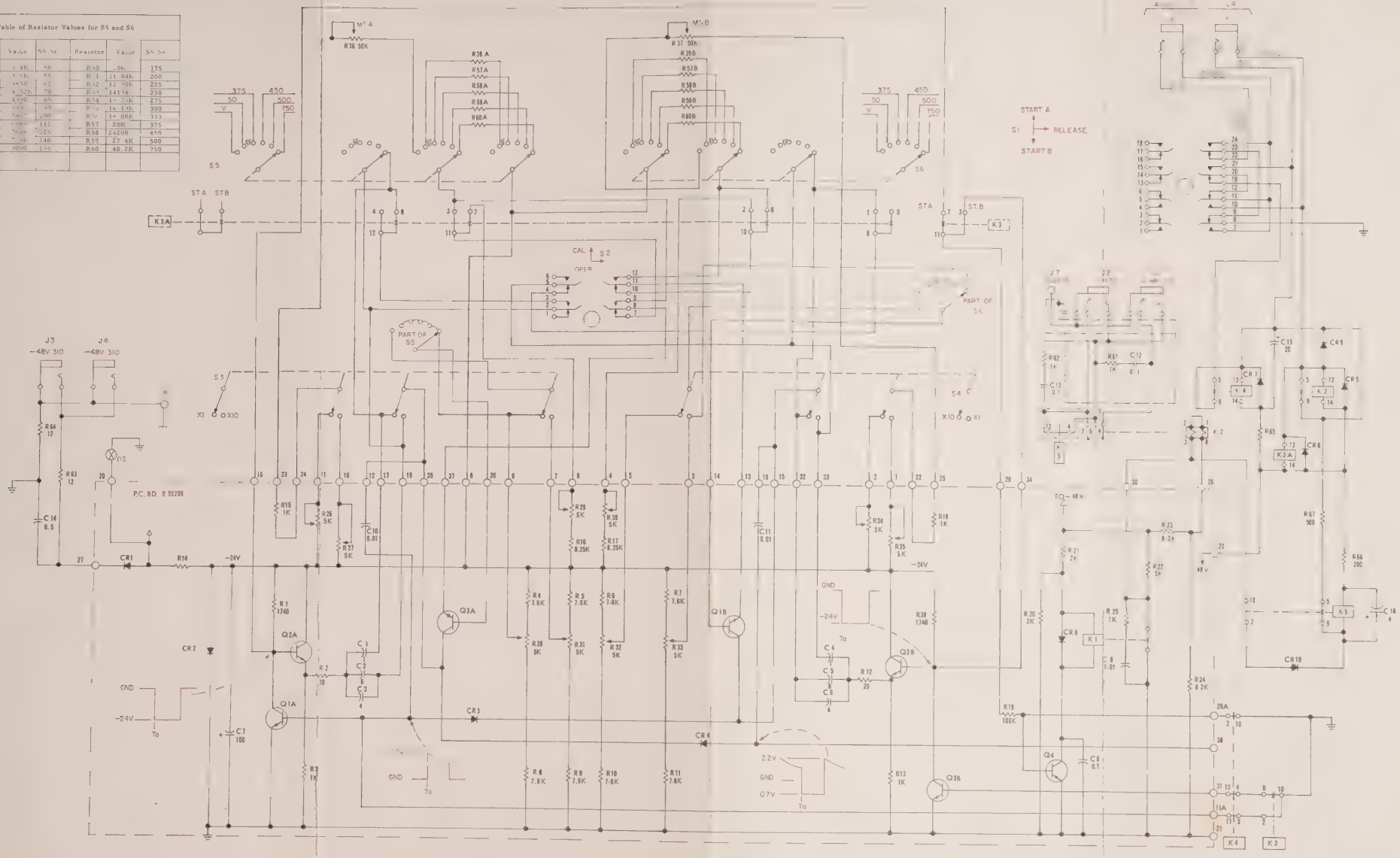


Fig. 3-1 TTS 75A Schematic Diagram

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 CALIBRATION

4.2 The following procedure will allow the user to recalibrate or perform routine calibration checks of the set.

NOTE

The accuracy of this instrument can be no better than the equipment used for calibration and the accuracy to which the adjustments are performed.

4.3 PRELIMINARY PROCEDURE

a. Remove the set from its case by loosening the four #10 screws in the corners of the front panel.

b. The location of the calibration potentiometers is shown in Fig. 5-1

c. Use a counter (NEC TTS 80B) or equivalent for measurement of output pulses.

d. Remove Relay K5 from its socket.

e. Arrange the equipment as shown in Fig. 4-1.

f. Using a cord with a tip-sleeve plug, connect it to either of the 48 volt jacks. Connect the other end of the cord to a 48 volt battery supply. The tip must be connected to the battery negative and the sleeve to ground. If the correct connection is made, the green indicator lamp lights. For proper operation, the DC power supply should be 48 volts ± 10 volts.

4.4 A FIXED INTERVAL CALIBRATION (222 ms).

a. Set the TTS 75A controls as follows:

1. OPERATE/CALIBRATE key to OPERATE.

2. A and B TIME MS multiplier switch to X1.

3. A TIME MS control to 100.

4. B TIME MS control to 100.

5. A switch to V.

6. B switch to V.

7. START A-START B key to START A.

b. Adjust R30 until the counter reads 222 ms.

4.5 B FIXED INTERVAL CALIBRATION

a. Set the START A-START B key to START B. Follow steps 4.4 in adjusting CAL POT, R29.

4.6 A TIME MS Calibration 10 to 100 ms. Arrange the equipment as shown in Fig. 4-2.

a. Set the TTS 75A control as follows:

1. OPERATE/CALIBRATE key to CALIBRATE.

2. A and B TIME MS multiplier switch to X1.

3. A TIME MS control to 100.

4. B TIME MS control to 100.

5. A switch to V.

6. Switch B to V.

7. START A-START B key to START B

b. Adjust R28 until the counter reads 100 ms.

c. Rotate the B TIME MS control to 10.

d. Adjust R26 until the counter reads 10 ms.

e. Because of interaction effects it will be necessary to repeat these steps until both R26 and R28 are in proper adjustment.

f. Lock both R26 and R28 with glyptol or equivalent and remeasure to make sure no change has occurred.

4.7 B TIME MS CALIBRATION 10 TO 100MS.

a. Set the START A-START B key to START A.

b. Follow steps in 4.6 except adjust R33 and R35.

4.8 A TIME MS CALIBRATION 100 TO 1000 MS.

a. Set the TTS 75A controls as follows:

1. OPERATE/CALIBRATE key to CALIBRATE.

2. A and B TIME MS multiplier switches to X10.

3. A TIME MS control to 1000.

4. B TIME MS control to 500.

5. A switch to V.

6. B switch to V.

7. START A-START B key to START A.

b. Adjust R31 until the counter reads 1000 ms.

c. Rotate the A TIME MS control to 10.

d. Adjust R27 until the counter reads 100 ms.

e. Because of interaction effects, it will be necessary to repeat these steps until both R27 and R31 are in proper adjustment.

f. Lock R27 and R31 with glyptol or equivalent and remeasure to make sure no change has occurred.

4.9 B TIME MS CALIBRATION 1000MS

a. Set the START A-START B key to START B.

b. Follow steps in 4.8 except adjust R34 and R32.

4.10 MAINTENANCE

4.11 In the event the set malfunctions, the following procedure, with reference to the Circuit Description, will help in locating the trouble.

4.12 Remove the set from its case by loosening the four #10 screws located in the corners of the front panel.

4.13 Apply power to the set (48V) and check the -24 volts ±1 volt regulated at CR2. If this voltage is correct continue with the next step.

4.14 With a cathode ray oscilloscope in its DC mode, check the wave-forms shown on the schematic diagram, Fig. 4 . Use a high impedance probe (10 Megohms) and trigger the cathode ray oscilloscope externally from either the collector of Q1A or Q3B.

4.15 If the timing circuit is functioning properly, proceed to the output stage, Q4, and the output relay, K1. A steady clicking sound from K1 indicates normal operation.

4.16 It is advisable to recalibrate the timing circuits if any components are replaced dur-

ing maintenance.

4.17 FIELD CHECK. For routine field check, the following procedure is suggested.

a. Set the TTS 75A controls as follows:

1. OPERATE/CALIBRATE key to CALIBRATE.

2. A and B TIME MS multiplier switch to X1.

3. A TIME MS control to 50.

4. B TIME MS control to 50.

5. A switch to V.

6. B switch to V.

7. START A-START B key to START A.

b. The V-M output should be 10 pps at 50% break.

c. Change the A and B TIME MS multiplier switch to X10.

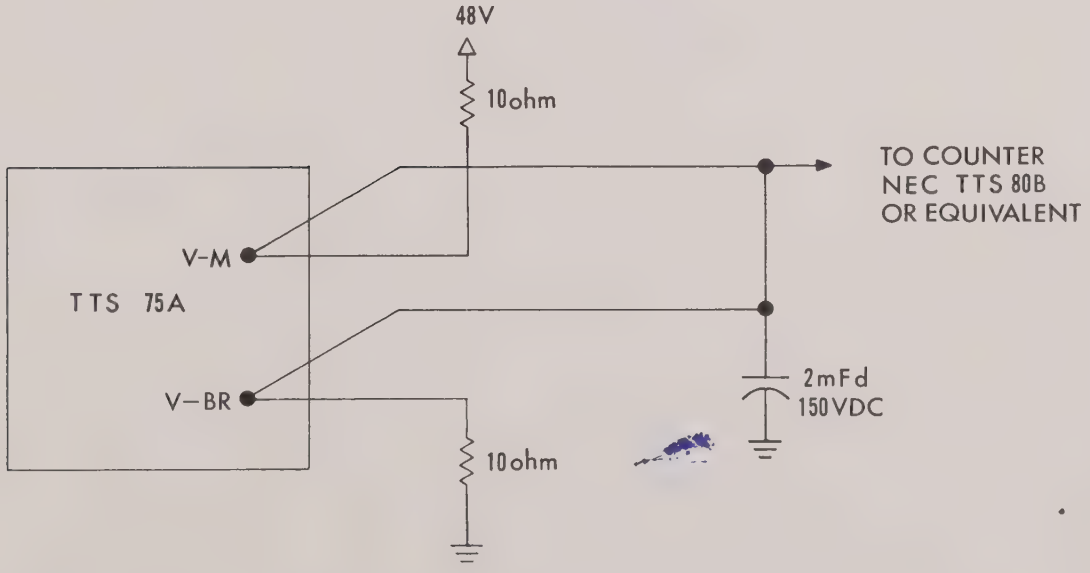
d. The V-M output should be 1 pps at 50% break.

e. Set the A and B switches to 50.

f. The V-M output should be 10 pps at 50% break.

g. Set the A and B switches to 500.

h. The V-M output should be 1 pps at 50% break.



NOTE: Before connecting this circuit remove relay K5.

Fig. 4-1 Test Set-up for Calibration

SECTION 5

ELECTRONIC PARTS LIST

5.1 INTRODUCTION The following pages contain the parts list for the Model TTS 75A.

5.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of codes and their respective manufacturers is given on page 5-9.

5.3 Abbreviations used in parts list.

C - capacitor
R - resistor
S - switch
fxd - fixed
cer disc - ceramic disc
od - orange drop
elec - electrolytic
var - variable
ww - wirewound
mf - metal film
comp - composition
mp - metalized paper

Main Assembly

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C12	C: fxd cer disc 0.1μF 75V	13606	DDA-104
C13	C: fxd cer disc 0.1μF 75V	13606	DDA-104
C14	C: fxd od 0.5μF 75V	13606	225P
C15	C: fxd elec 20μF 50V	13606	TE1305
C16	C: fxd elec 20μF 50V	13606	TE1302.1
R36	R: var ww 50K 5% 1% linearity	12697	CM-32854
R37	R: var ww 50K 5% 1% linearity	12697	CM-32854
R39A	R: fxd mf 3.4K 1% ½W	07716	CECTO
R40A	R: fxd mf 3.5K 1% ½W	07716	CECTO
R41A	R: fxd mf 3830Ω 1% ½W	07716	CECTO
R42A	R: fxd mf 4.32K 1% ½W	07716	CECTO
R43A	R: fxd mf 4490Ω 1% ½W	07716	CECTO
R44A	R: fxd mf 5303Ω 1% ½W	07716	CECTO
R45A	R: fxd mf 5857Ω 1% ½W	07716	CECTO
R46A	R: fxd mf 6589Ω 1% ½W	07716	CECTO
R47A	R: fxd mf 7608Ω ½W 1%	07716	CECTO
R48A	R: 7.9K 1% ½W fxd mf	07716	CECTO
R49A	R: fxd mf 9090Ω 1% ½W	07716	CECTO
R50A	R: fxd mf 10K 1% ½W	07716	CECTO
R51A	R: fxd mf 11.84K ½W 1%	07716	CECTO
R52A	R: fxd mf 12.36K 1% ½W	07716	CECTO
R53A	R: fxd mf 14.134K ½W 1%	07716	CECTO
R54A	R: fxd mf 15.75K ½W 1%	07716	CECTO
R55A	R: fxd mf 16.19K ½W 1%	07716	CECTO
R56A	R: fxd mf 18.08K ½W 1%	07716	CECTO
R57A	R: fxd mf 20K ½W 1%	07716	CECTO
R58A	R: fxd mf 24.208K ½W 1%	07716	CECTO
R59A	R: fxd mf 26.19K ½W 1%	07716	CECTO
R60A	R: fxd mf 40.2K ½W 1%	07716	CECTO
R39B	R: fxd mf 3.4K ½W 1%	07716	CECTO
R40B	R: fxd mf 3.5K ½W 1%	07716	CECTO
R41B	R: fxd mf 3830Ω ½W 1%	07716	CECTO
R42B	R: fxd mf 4.32K ½W 1%	07716	CECTO
R43B	R: fxd mf 4990Ω ½W 1%	07716	CECTO
R44B	R: fxd mf 5303Ω ½W 1%	07716	CECTO
R45B	R: fxd mf 5857Ω ½W 1%	07716	CECTO
R46B	R: fxd mf 6589Ω ½W 1%	07716	CECTO
R47B	R: fxd mf 7608Ω ½W 1%	07716	CECTO
R48B	R: fxd mf 7.9K ½W 1%	07716	CECTO
R49B	R: fxd mf 9090Ω ½W 1%	07716	CECTO
R50B	R: fxd mf 10K ½W 1%	07716	CECTO
R51B	R: fxd mf 11.84K ½W 1%	07716	CECTO
R52B	R: fxd mf 12.36K ½W 1%	07716	CECTO
R53A	R: fxd mf 14.134K ½W 1%	07716	CECTO
R54B	R: fxd mf 15.75K ½W 1%	07716	CECTO
R55B	R: fxd mf 16.19K ½W 1%	07716	CECTO
R56B	R: fxd mf 18.08K ½W 1%	07716	CECTO
R57B	R: fxd mf 20K ½W 1%	07716	CECTO

Main Assembly (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
R58B	R: fxd mf 24.208K $\frac{1}{2}$W 1%	07716	CECTO
R59B	R: fxd mf 26.19K $\frac{1}{2}$W 1%	07716	CECTO
R60B	R: fxd mf 40.2K $\frac{1}{2}$W 1%	07716	CECTO
R61	R: fxd comp 1K 5% $\frac{1}{2}$W	01121	EB1025
R62	R: fxd comp 1K 5% $\frac{1}{2}$W	01121	EB1025
R63	R: fxd comp 12Ω 5% 2W	01121	EB1215
R64	R: fxd comp 12Ω 5% 2W	01121	EB1215
R65	R: fxd comp 1K 5% 3$\frac{1}{4}$W	13606	242E1025
R66	R: fxd comp 400Ω 5% 3W	13606	242E5015
R67	R: fxd ww 500Ω 5% 3W	44655	4432
J1	Jack: telephone jack (V-BR)	82389	MT-332B
J2	Jack: telephone jack (V-M)	82389	MT-332B
J3	Jack: telephone jack (48V)	82389	MT-331
J4	Jack: telephone jack (48V)	82389	MT-331
J5	Jack: telephone jack (remote)	82389	MT-331
J6	Jack: telephone jack (remote)	82389	MT-331
J7	Binding post: (sleeve)	83330	137-SP
J8	Binding post: (chassis gnd)	83330	137-SP
S1	S: key, locking (A/B)	78957	173P
S2	S: key, locking (CAL/OPER)	78957	170E
S3	S: toggle SPDT (A multiplier)	31356	JMT-323
S4	S: toggle SPDT (B multiplier)	31356	JMT-323
S5	S: rotary 3 pole 23 pos	71450	PA4004
S6	S: rotary 3 pole 23 pos	71450	PA4004
CR5	Diode: rectifier	80368	1N2069
CR6	Diode: rectifier	80368	1N2069
CR7	Diode: rectifier	80368	1N2069
CR9	Diode: rectifier	80368	1N2069
CR10	Diode: rectifier	80368	1N2069
K2	Relay: polar	78277	72AOZ1000TS-SIL
K3	Relay: switching	77342	KHP-17-D11-24
K3A	Relay: switching	77342	KHP-17-D11-24
K4	Relay: switching	77342	KHP-17-D11-24
K5	Relay: switching	77342	KHP-17-D11-24
DS1	Lamp	80368	60A

PC Bd. E95206

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C1	C: fxd mp 1μF 200V	13606	155P1.0-200
C2	C: fxd mp 6μF 150V	13606	121P60591R5S4
C3	C: fxd mp 4μF 150V	13606	121P40591R5S4
C4	C: fxd mp 1μF 200V	13606	155P1.0-200
C5	C: fxd mp 6μF 150V	13606	121P60591R5S4
C6	C: fxd mp 4μF 150V	13606	121P40591R5S4
C7	C: fxd elec 100μF 50V	13606	TVA-1310
C8	C: fxd od 0.01μF 75V	13606	225P
C9	C: fxd od 0.12μF 75V	13606	225P
C10	C: fxd od 0.1μF 100V	13606	225P
C11	C: fxd od 0.1μF 100V	13606	225P
R1	R: fxd mf 1728Ω $\frac{1}{2}$W 1%	07716	CECTO
R2	R: fxd mf 20Ω 1% $\frac{1}{2}$W	07716	CECTO
R3	R: fxd mf 1.0K $\frac{1}{2}$W 1%	07716	CECTO
R4	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R5	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R6	R: fxd mf 1728Ω $\frac{1}{2}$W 1%	07716	CECTO
R7	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R8	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R9	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R10	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R11	R: fxd mf 7608Ω $\frac{1}{2}$W 1%	07716	CECTO
R12	R: fxd mf 20Ω $\frac{1}{2}$W 1%	07716	CECTO
R13	R: fxd mf 1.0K $\frac{1}{2}$W 1%	07716	CECTO
R14	R: fxd ww 400Ω 5% 3$\frac{1}{4}$W	44655	4408
R15	R: fxd mf 1.0K 1% $\frac{1}{2}$W	07716	CECTO
R16	R: fxd mf 8.25K 1% $\frac{1}{2}$W	07716	CECTO
R17	R: fxd mf 8.25K 1% $\frac{1}{2}$W	07716	CECTO
R18	R: fxd mf 1.0K 1% $\frac{1}{2}$W	07716	CECTO
R19	R: fxd comp 100K 5% $\frac{1}{2}$W	01121	EB3035
R20	R: fxd ww 2K 5% 3$\frac{1}{4}$W	44655	4430
R21	R: fxd ww 2K 5% 3$\frac{1}{4}$W	44655	4430
R22	R: fxd ww 5K 5% 3$\frac{1}{4}$W	44655	4432
R23	R: fxd ww 8.2K 5% 3$\frac{1}{4}$W	44655	4430
R24	R: fxd ww 8.2K 5% 3$\frac{1}{4}$W	44655	4430
R25	R: fxd comp 1K 5% $\frac{1}{2}$W	01121	EB1025
R26	R: var 5K $\frac{1}{4}$W	71450	UPE200
R27	R: var 5K $\frac{1}{4}$W	71450	UPE200
R28	R: var 5K $\frac{1}{4}$W	71450	UPE200
R29	R: var 5K $\frac{1}{4}$W	71450	UPE200
R30	R: var 5K $\frac{1}{4}$W	71450	UPE200
R31	R: var 5K $\frac{1}{4}$W	71450	UPE200
R32	R: var 5K $\frac{1}{4}$W	71450	UPE200
R33	R: var 5K $\frac{1}{4}$W	71450	UPE200
R34	R: var 5K $\frac{1}{4}$W	71450	UPE200
R35	R: var 5K $\frac{1}{4}$W	71450	UPE200
R38	R: fxd mf 1728Ω 1% $\frac{1}{2}$W	07716	CECTO

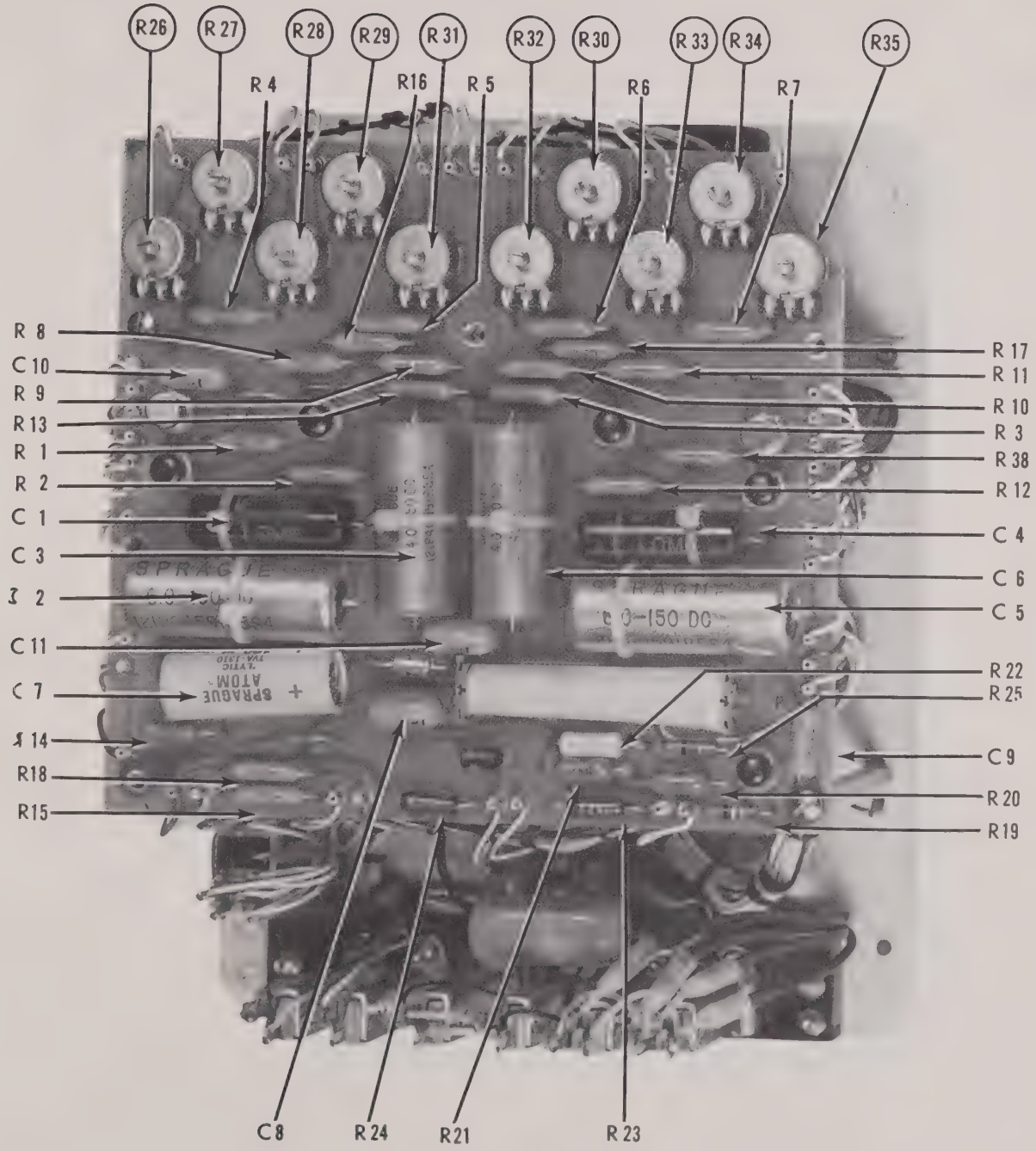


Fig. 5-1 PC Board E95206

PC Bd. E95206 (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
Q1A	Transistor: PNP	17803	2N3638A
Q2A	Transistor: PNP	17803	2N3638
Q3A	Transistor: NPN	49671	2N2102
Q1B	Transistor: NPN	49671	2N2102
Q2B	Transistor: PNP	17803	2N3638
Q3B	Transistor: PNP	17803	2N3638A
Q4	PNP Transistor	17803	2N4354
CR1	Diode: rectifier	80368	1N2069
CR2	Diode: zener	15873	1N3029B
CR3	Diode: rectifier	12065	1N4148
CR4	Diode: rectifier	12065	1N4148
CR8	Diode: rectifier	12065	1N4148
K1	Relay: reed	71482	CRZ-1056

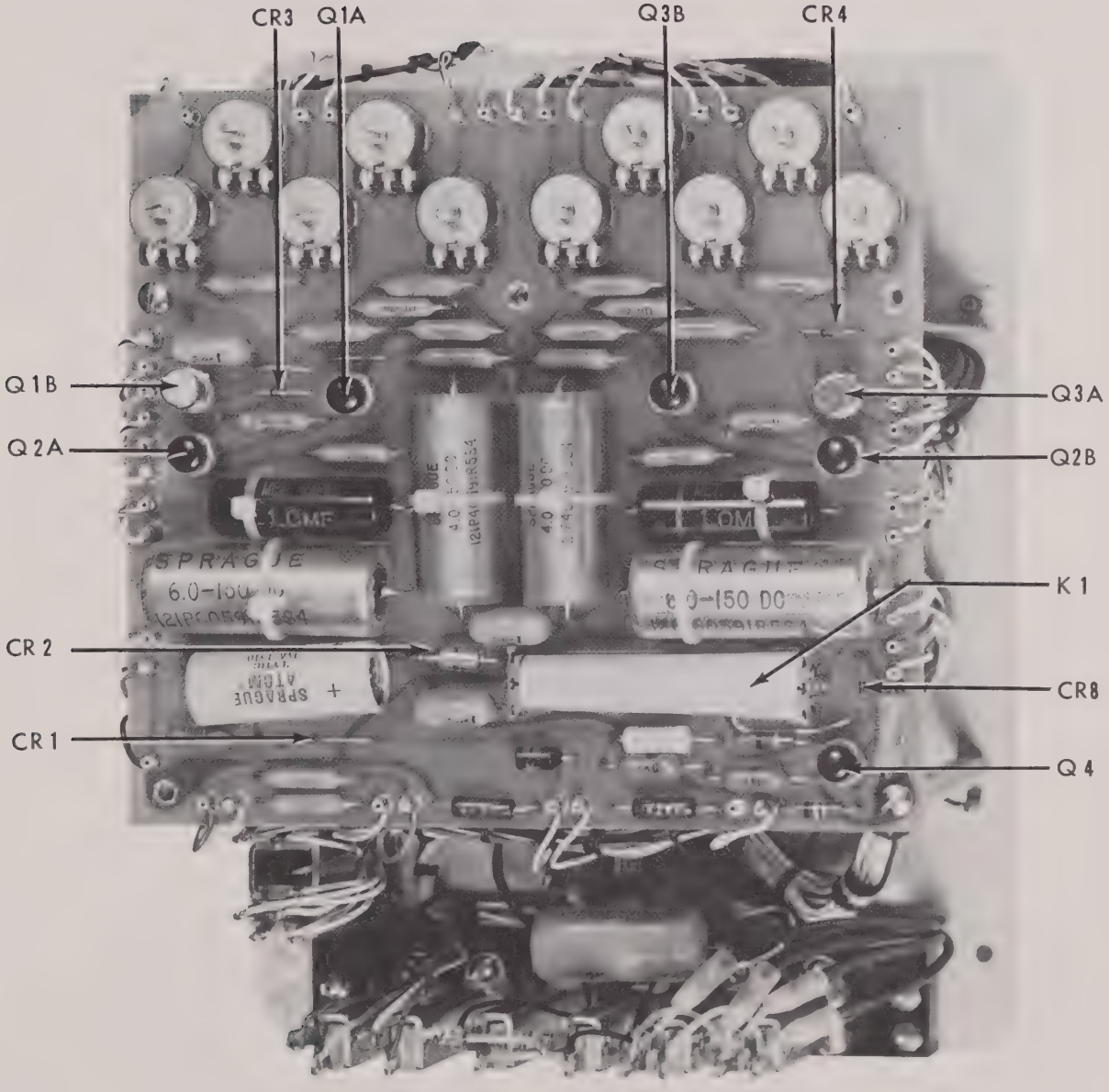


Fig. 5-2 PC Board E95206

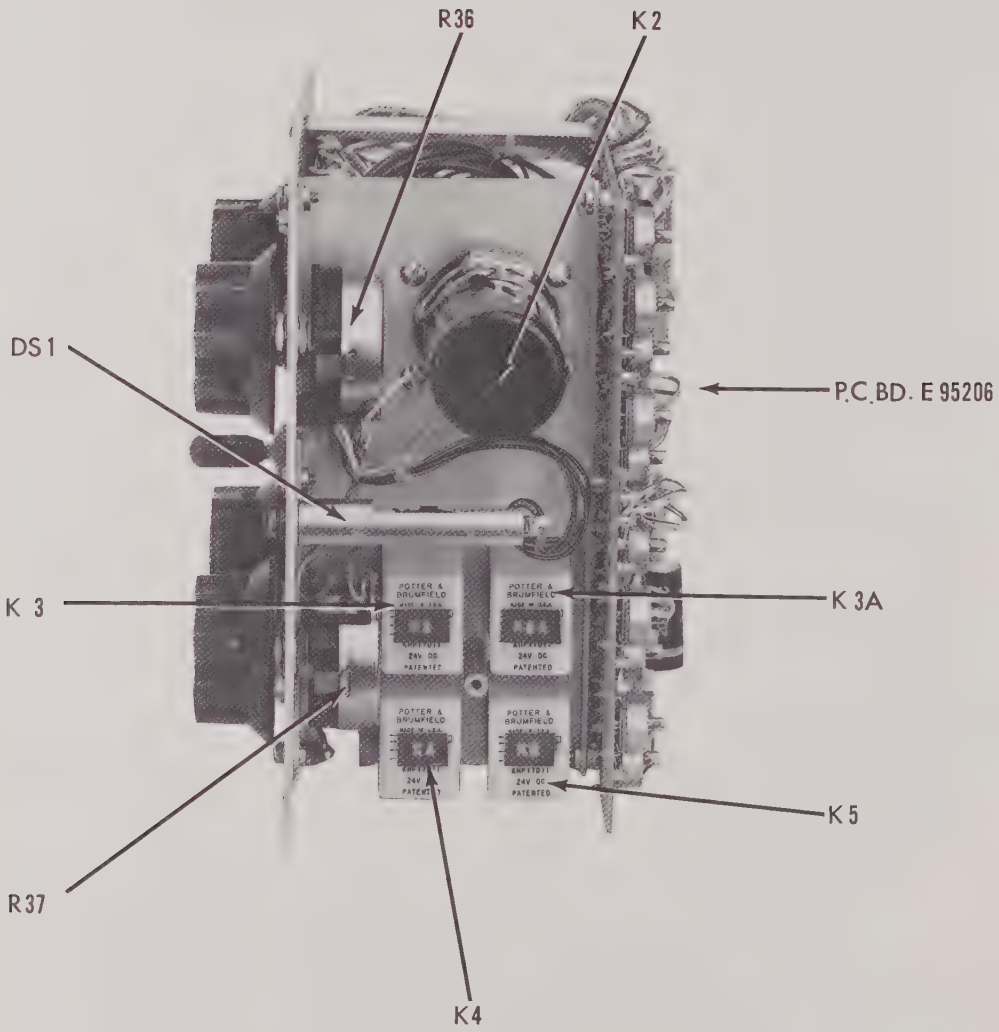
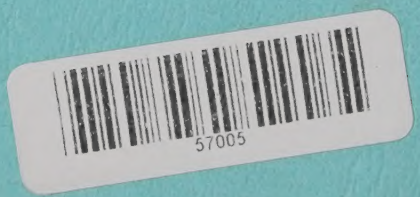


Fig. 5-3 TTS 75A Top View

LIST OF MANUFACTURERS

Code No.	Company
01121	Allen Bradley
07716	IRC
12065	Transitron
12697	Clarostat
13606	Sprague
15873	Motorola
17803	Fairchild
31356	J-B-T
44655	Ohmite
49671	RCA
71450	CTS
71482	C.P. Clare
77342	Potter & Brumfield
78277	Sigma
78957	Stromberg-Carlson
80368	Sylvania
82389	Switchcraft
83330	H.H. Smith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